

8092-EN-01

DTIC

CHARACTERISATION OF BACKGROUND BIOLOGICAL AEROSOL

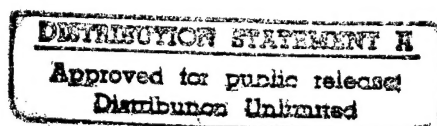
S.G. JENNINGS

(Principal Investigator)
University College Galway

CONTRACT NUMBER: N68171-96-C-9124

2nd Interim Report

January 1997 - March 1997



DTIC QUALITY INSPECTED 4

The research reported in this document has been made possible through the support and sponsorship of the U.S. Government through its European Research Office of the U.S. Army. This report is intended only for the internal management use of the Contractor and the U.S. Government.

19970605 144

REPORT DOCUMENTATION PAGE			Form Approved OMB No 0704-0188	
<small>Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Service, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302, and to the Office of Management and Budget, Paperwork Reduction Project (0704-0188), Washington, DC 20503.</small>				
1. AGENCY USE ONLY (Leave blank)	2. REPORT DATE May 15 1997	3. REPORT TYPE AND DATES COVERED Interim Report: Jan.'97-Mar.'97		
4. TITLE AND SUBTITLE Characterisation of Background Biological Aerosol		5. FUNDING NUMBERS N68171-96-C-9124		
6. AUTHOR(S) S.G. Jennings and C.M. Kenny				
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) University College Galway, Ireland		8. PERFORMING ORGANIZATION REPORT NUMBER 0002		
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES) U.S. Army Research, Development & Standardization Group, 223 Old Marylebone Road, London NW1 5TH, U.K.		10. SPONSORING/MONITORING AGENCY REPORT NUMBER		
11. SUPPLEMENTARY NOTES None				
12a. DISTRIBUTION / AVAILABILITY STATEMENT Unlimited		12b. DISTRIBUTION CODE		
13. ABSTRACT (Maximum 200 words) <p>Sampling of ambient air using a glass cyclone system for fluorescence background determination is described. Weekly samples were taken at the University College Galway's atmospheric research field station at Mace Head, on the west coast of Ireland. The bioaerosol sampling system and procedures used have previously been discussed in the 1st Interim Report. Use is made of a fluorescence protocol developed in the ERDEC Laboratories.</p> <p>Representative fluorescence excitation/emission spectra are presented for both background and polluted conditions. In addition, mass distributions of both background and polluted air episodes at the Mace Head site are also presented.</p>				
14. SUBJECT TERMS		15. NUMBER OF PAGES 16		
		16. PRICE CODE		
17. SECURITY CLASSIFICATION OF REPORT Unclassified	18. SECURITY CLASSIFICATION OF THIS PAGE Unclassified	19. SECURITY CLASSIFICATION OF ABSTRACT Unclassified	20. LIMITATION OF ABSTRACT None	

CHARACTERISATION OF BACKGROUND BIOLOGICAL AEROSOL

Abstract

Sampling of ambient air using a glass cyclone system for fluorescence background determination is described. Weekly samples were taken at the University College Galway's atmospheric research field station at Mace Head, on the west coast of Ireland. The bioaerosol sampling system and procedures used have previously been discussed in the 1st Interim Report. Use is made of a fluorescence protocol developed in the ERDEC Laboratories.

Representative fluorescence excitation/emission spectra are presented for both background and polluted conditions. In addition, mass distributions of both background and polluted air episodes at the Mace Head site are also presented.

1. Introduction

The atmospheric research station at Mace Head offers an ideal remote location for bioaerosol sampling that is virtually free of airborne pollutants. The prevailing wind flow across Ireland is out of the southwest from the Atlantic ocean which ensures that the atmospheric aerosol reaching western Ireland usually is a background aerosol, with few man made or local influences. As a region where natural aerosols are well characterised, Mace Head provides excellent clean baseline conditions against which detection of natural or man made simulant bioaerosols have the highest probability of being detected. Mace Head also offers the opportunity to study European continental emissions when the winds favor transport from that region.

2. Aerojet Glass Cyclone Sampler

The Aerojet General glass cyclone currently in use at Mace Head (made available by the Hampshire Glassware company) has been chosen for it's excellent performance. There are two criteria to be considered when discussing the overall performance of a bioaerosol sampler, (a) collection efficiency and (b) bioefficiency. The glass cyclone sampler has a high sampling efficiency which is reasonably independent of wind speed, aerosol diameter and

sampler orientation and has been proven to be a successful sampler for the collection of bioaerosol material.

3. Bioaerosol Fluorescence Determinations

Based on the fact that natural fluorophores occur intrinsically in all biological molecules, primary fluorescence measurements of the bioaerosol samples have been determined using a Perkin Elmer LS 50B fluorimeter available at University College Galway. The protocol used for fluorescence determinations and the wavelength values for the selected excitation/emission scans have been documented in the 1st Interim report.

4. Background Aerosol Characterisation

Representative emission spectra obtained from three hourly bioaerosol samples at Mace Head are shown in Figure 1 through Figure 3. These spectra are based on the Summer months of July and August 1996 and the Autumn months of September and October 1996 and include data from marine (wind sector 180-300°), and continental (wind sector 45-135°) air masses (Table1.).

Table 1. Bioaerosol measurement periods.

Season	Date	Wind Sector
Summer	07/10/96	Marine
	07/17/96	Continental
	08/01/96	Marine
Autumn	09/17/96	Continental
	09/26/96	Marine
	10/24/96	Marine

Spectra have been grouped by three characteristic excitation wavelengths 282, 350 and 450 nm, corresponding to the fluorescent amino acids, (excitation-emission maxima ~ 280/350 nm), the reduced nicotinamide adenine dinucleotides (excitation-emission maxima ~ 340/450 nm), and the flavin compounds, (excitation-emission maxima ~ 450/520 nm). Back trajectory

data for all selected dates are displayed in Figure 5 (a) to Figure 5 (f), courtesy of Peter Lynch and Liam Campbell at Met Éireann.

Fluorescence intensity values at the excitation wavelength 282 nm are highest on 07/10/96 (Figure 1 (a)), decreasing gradually from August to October (Figure 1 (c), 1 (f)). Values are particularly low on the 09/26/96 (Figure 1 (e)) and are less intense than continental values on the 09/17/96 (Figure 1 (d)). Intensity values at excitation 350 nm decrease significantly from July (Figure 2 (b)) to September (Figure 2 (d)) and fall to zero intensity by October (Figure 2 (f)). July 17th (Figure 2 (b)) continental values are higher than July 10th (Figure 2 (a)) marine values. Intensity values at 450 nm, are near zero from September (Figure 3 (d)) onwards, and similarly to excitation at 350 nm, the July 17th (Figure 3 (b)) continental values are higher than the July 10th (Figure 3 (a)) marine values. The fluorescence signal from the clean background sector is lower than from polluted continental air, on intercomparing adjacent sampling periods.

Aerosol particle mass concentration data corresponding to the Summer (July, August) cyclone sampling dates are shown in Figure 4 (a) to Figure 4 (c). This data has been derived from aerosol particle size distribution data collected using a TSI aerodynamic particle sizer. The calculated mass concentrations from the size distribution data (using a particle density of 1.79 g cm^{-3}) for the three periods of 07/10/96 (marine), 07/17/96 (continental) and 08/01/96 (marine) were $19.33 \text{ } \mu\text{g m}^{-3}$, $21.19 \text{ } \mu\text{g m}^{-3}$, and $27.14 \text{ } \mu\text{g m}^{-3}$ respectively.

Figure 1 (a) 07/10/96 Marine

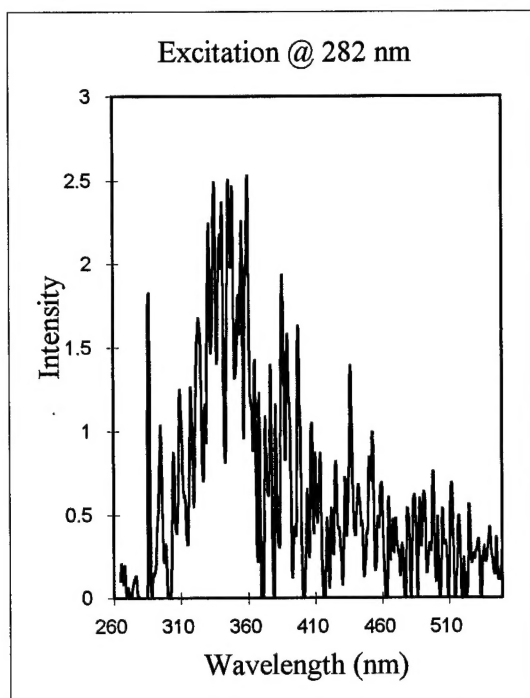


Figure 1 (b) 07/17/96 Continental

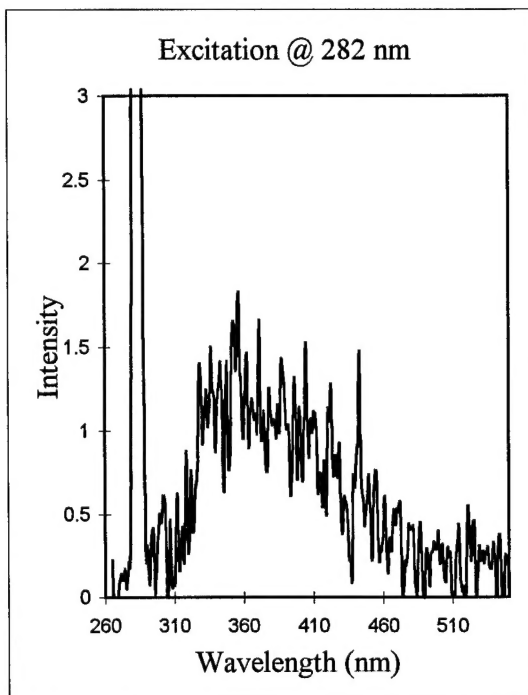


Figure 1 (c) 08/01/96 Marine

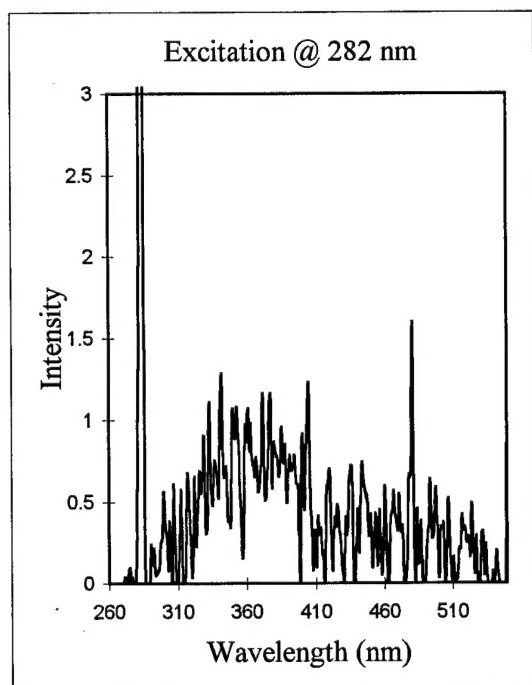


Figure 1 (d) 09/17/96 Continental

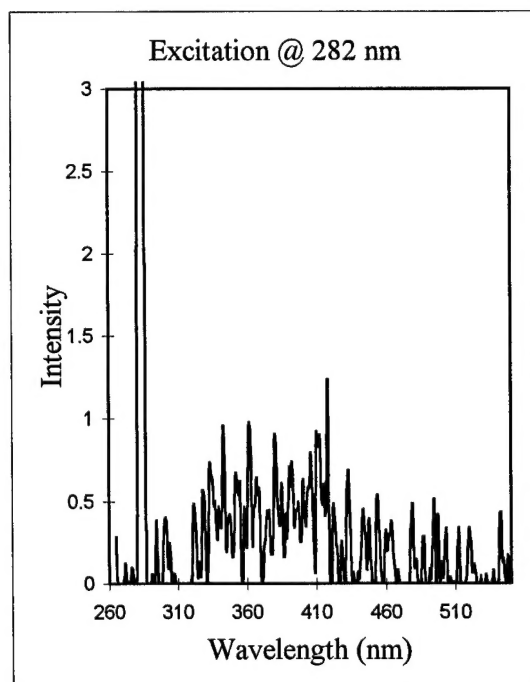


Figure 1 (e) 09/26/96 Marine

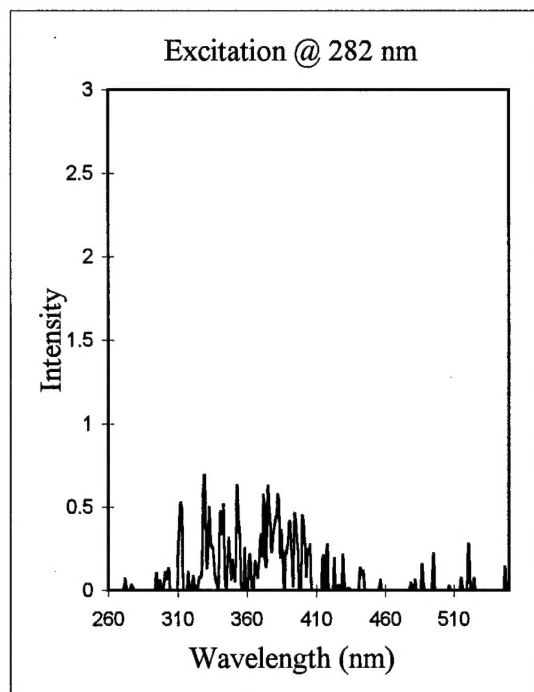


Figure 1 (f) 10/24/96 Marine

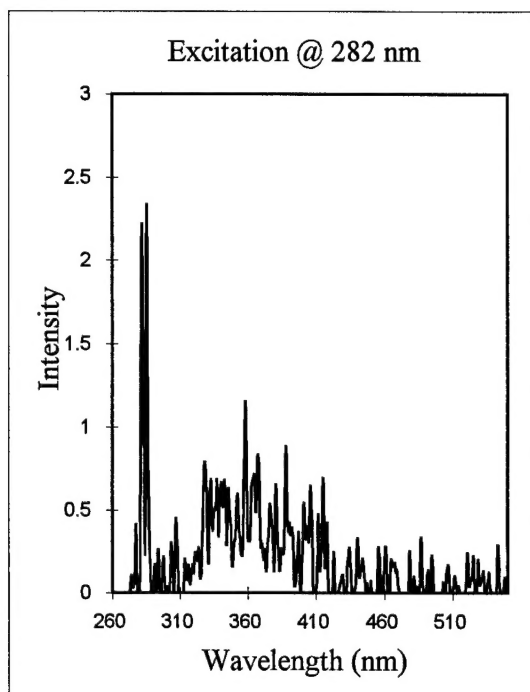


Figure 2 (a) 07/10/96 Marine

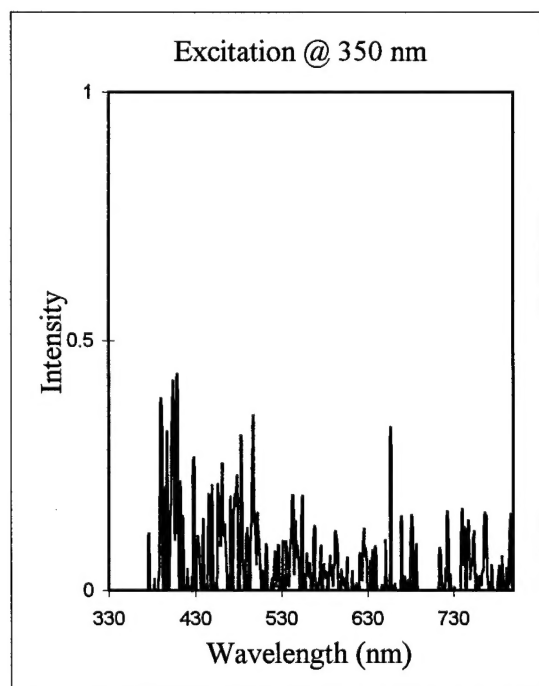


Figure 2 (b) 07/17/96 Continental

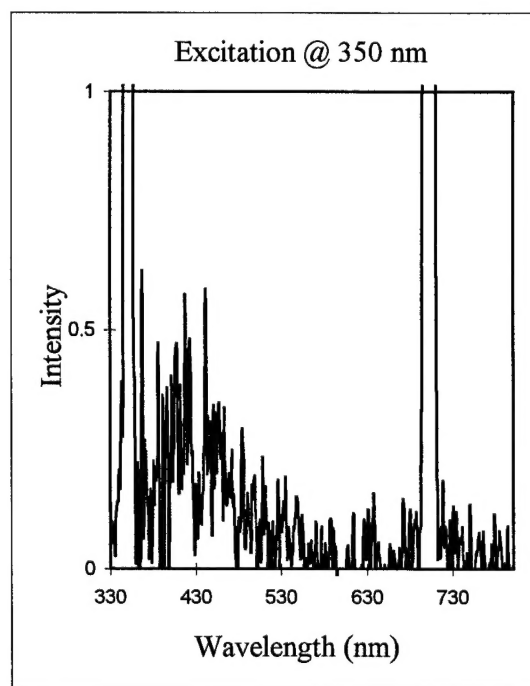


Figure 2 (c) 08/01/96 Marine

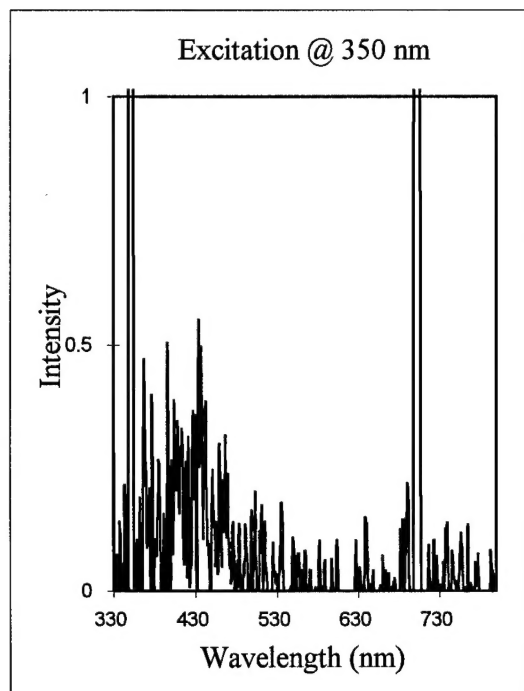


Figure 2 (d) 09/17/96 Continental

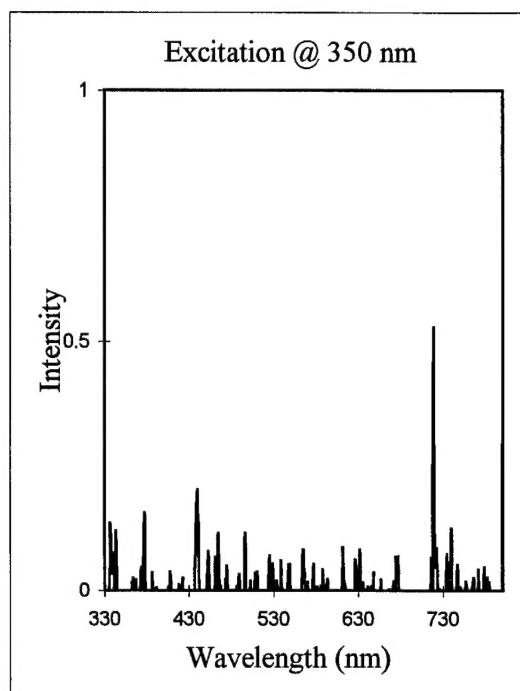


Figure 2 (e) 09/26/96 Marine

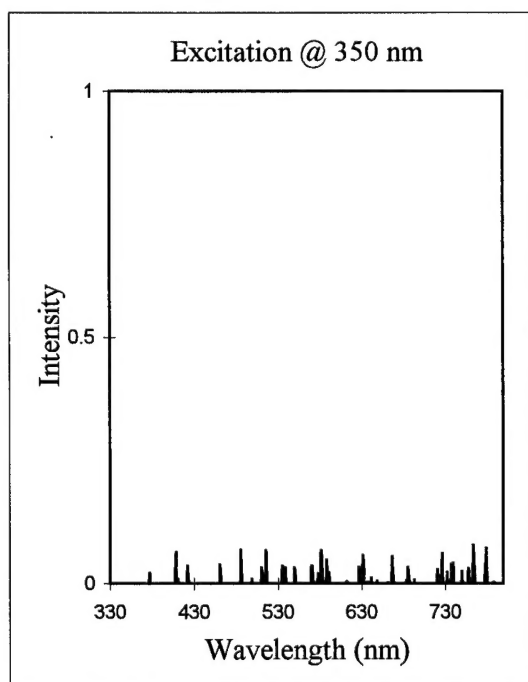


Figure 2 (f) 10/24/96 Marine

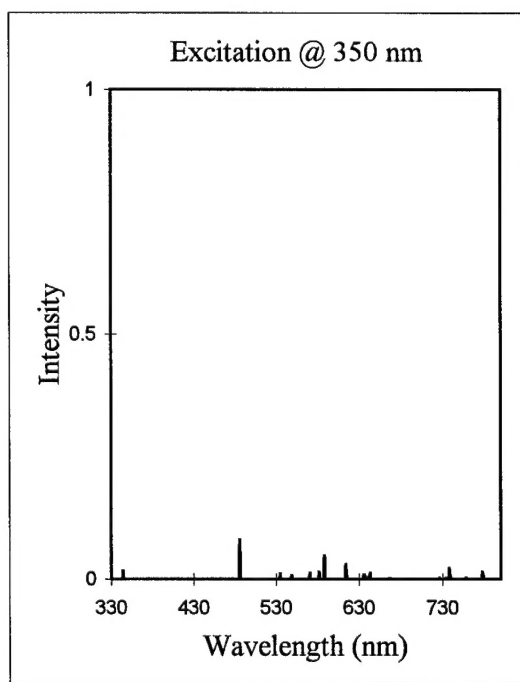


Figure 3 (a) 07/10/96 Marine

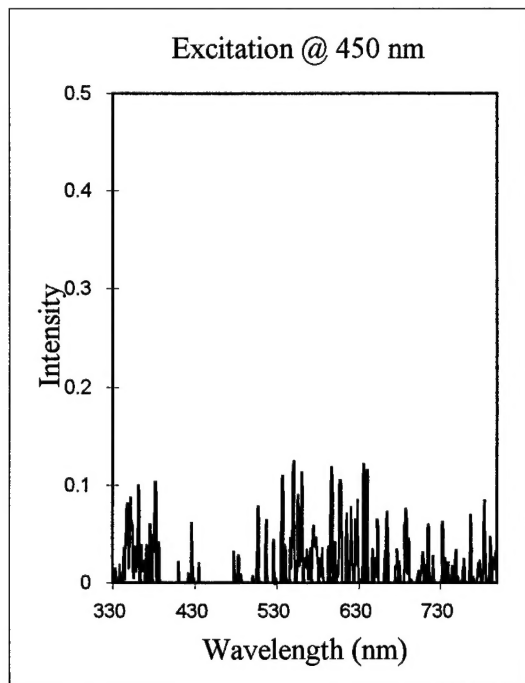


Figure 3 (b) 07/17/96 Continental

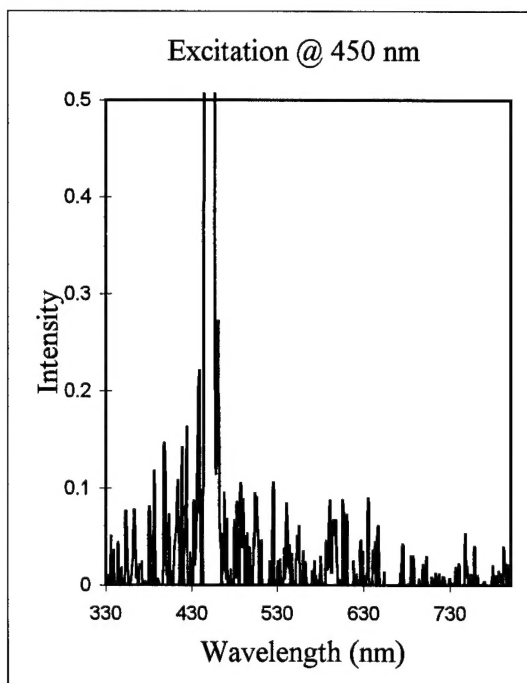


Figure 3 (c) 08/01/96 Marine

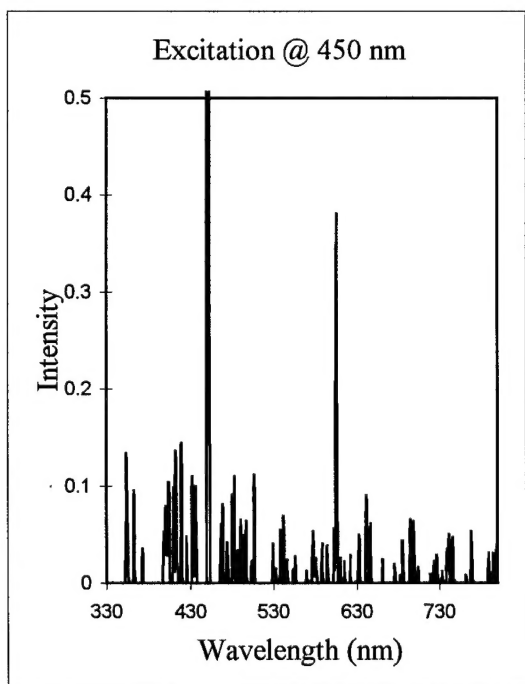


Figure 3 (d) 09/17/96 Continental

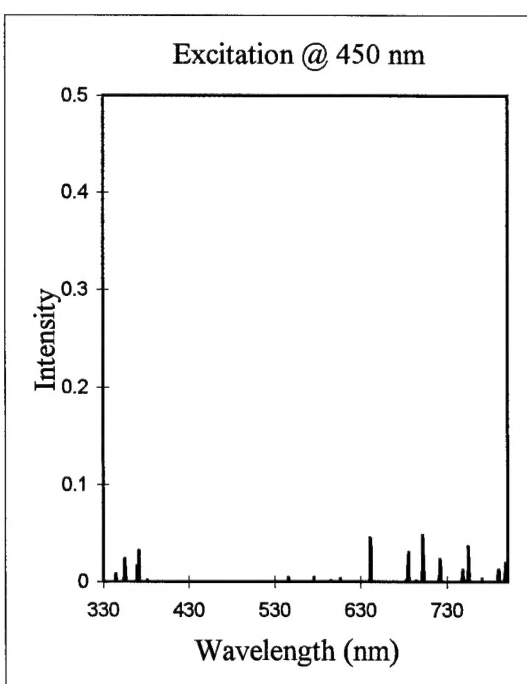


Figure 3 (e) 09/26/06 Marine

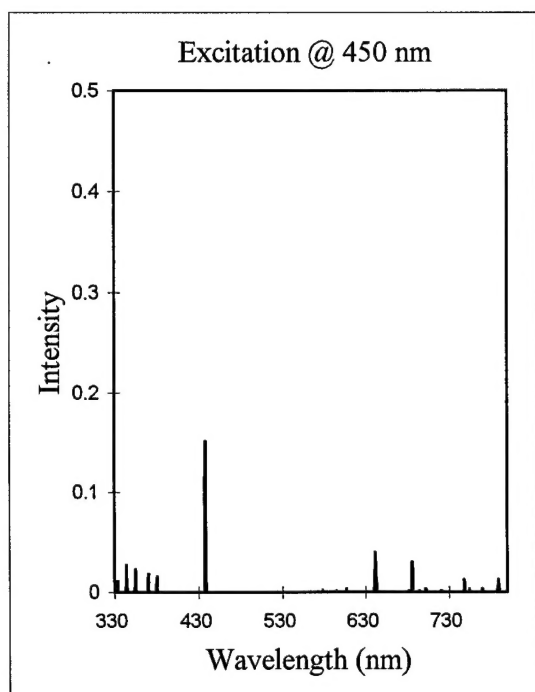


Figure 3 (f) 10/24/96 Marine

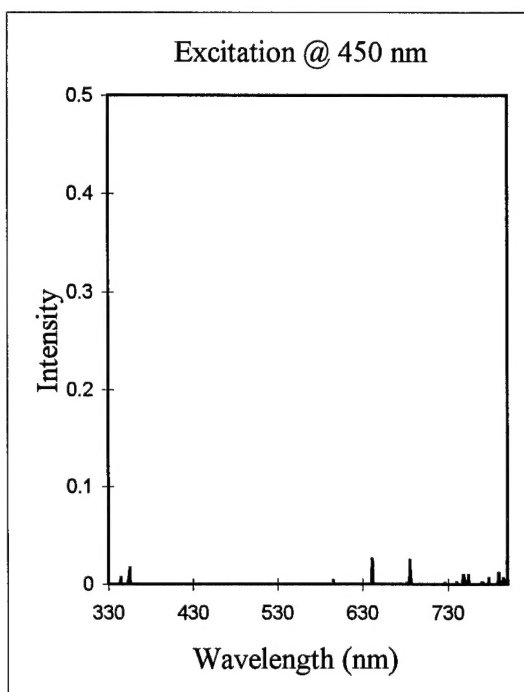


Figure 4 (a)

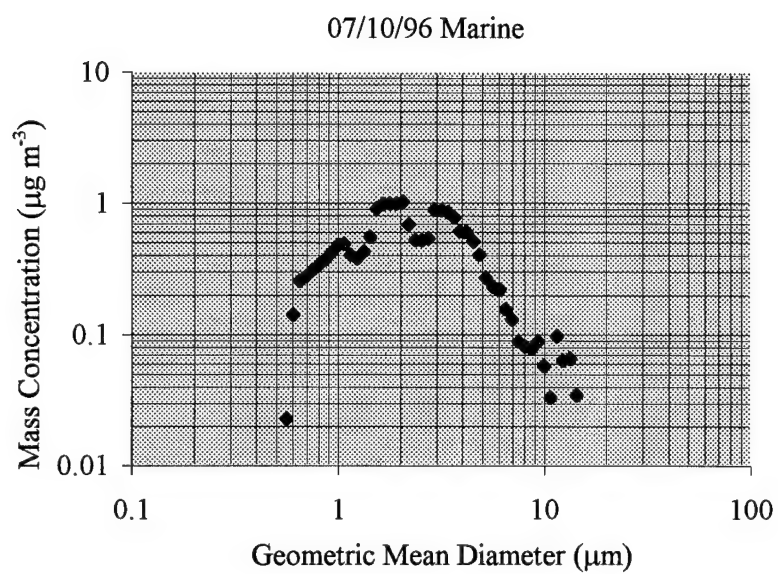


Figure 4 (b)

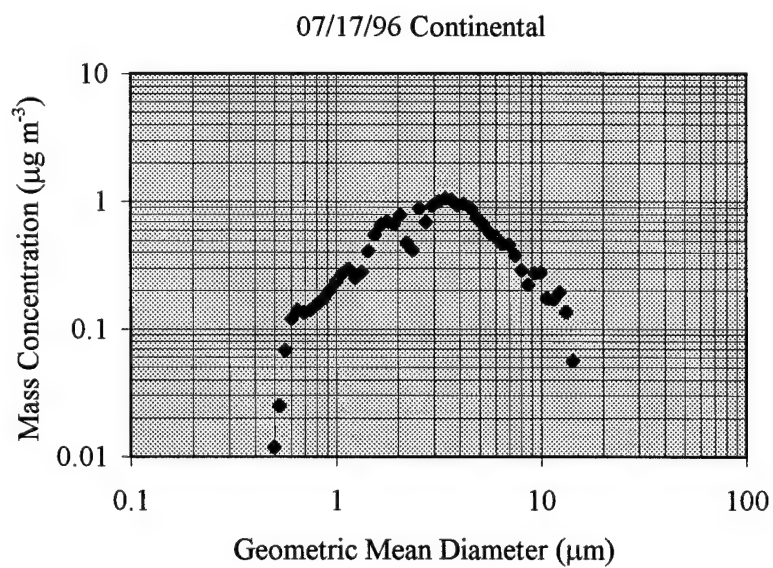


Figure 4 (c)

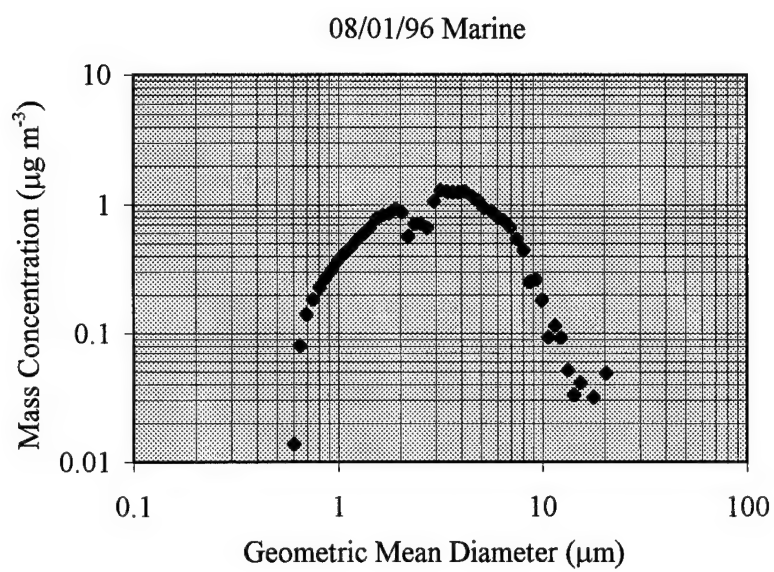
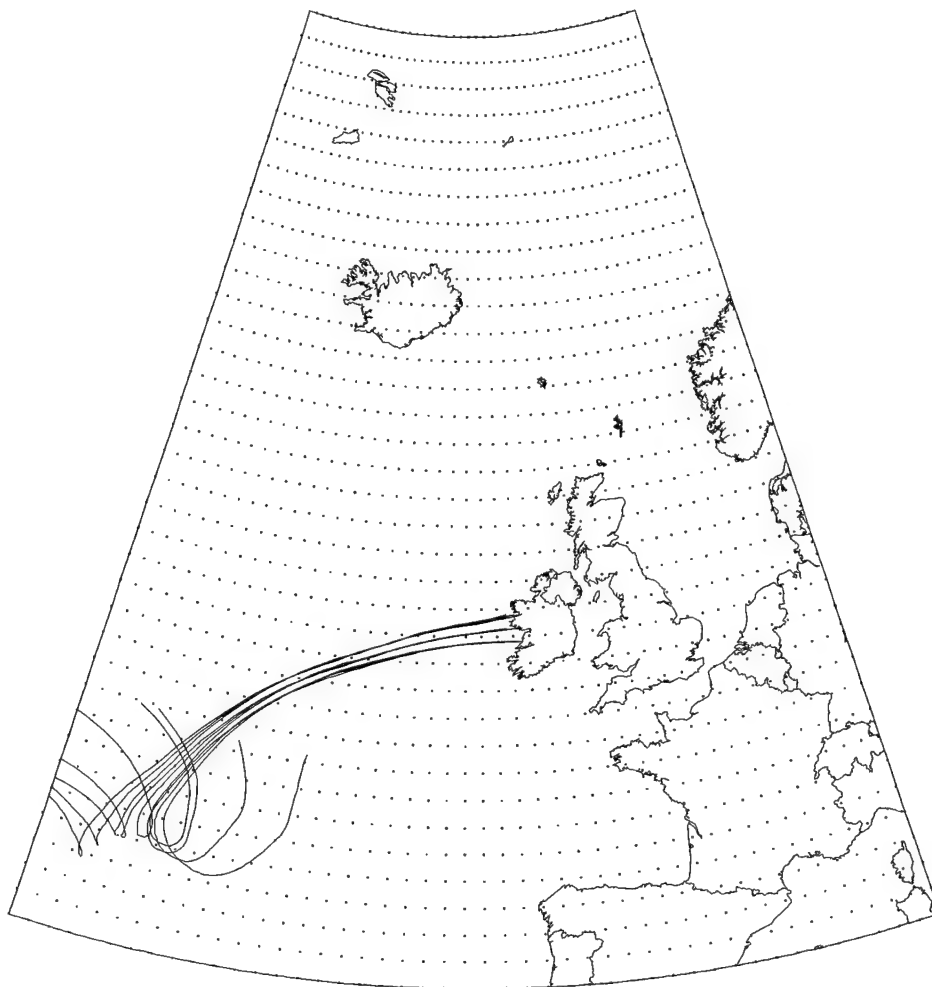
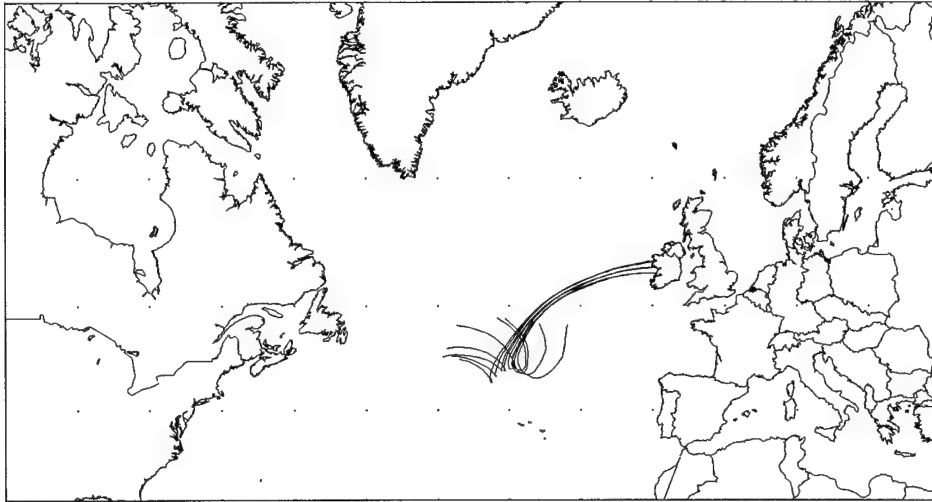
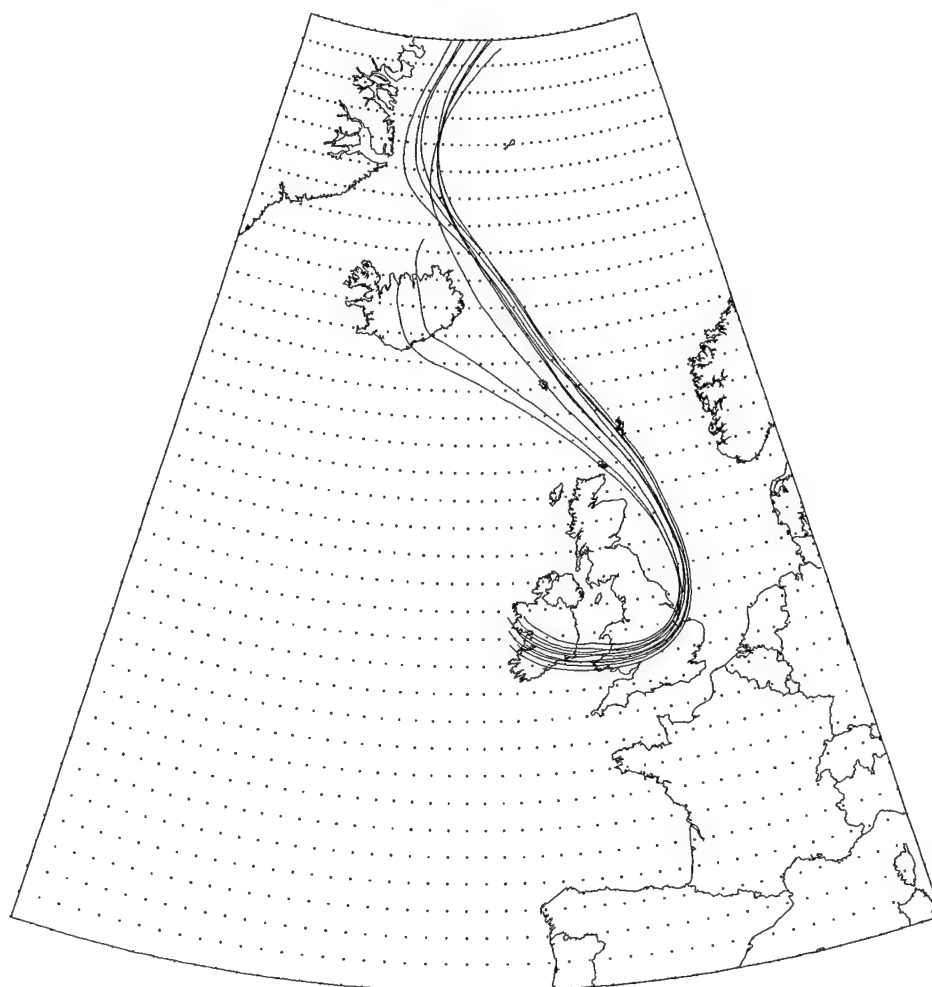
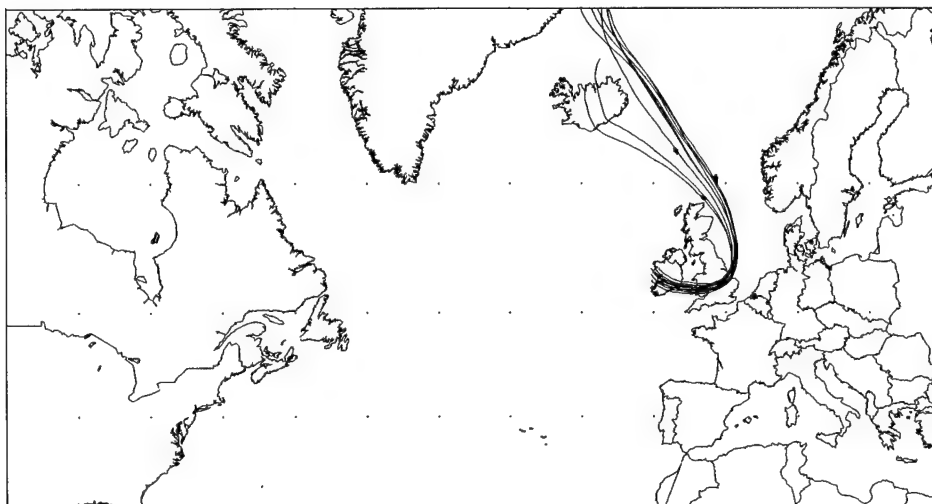


Figure 5 (a)



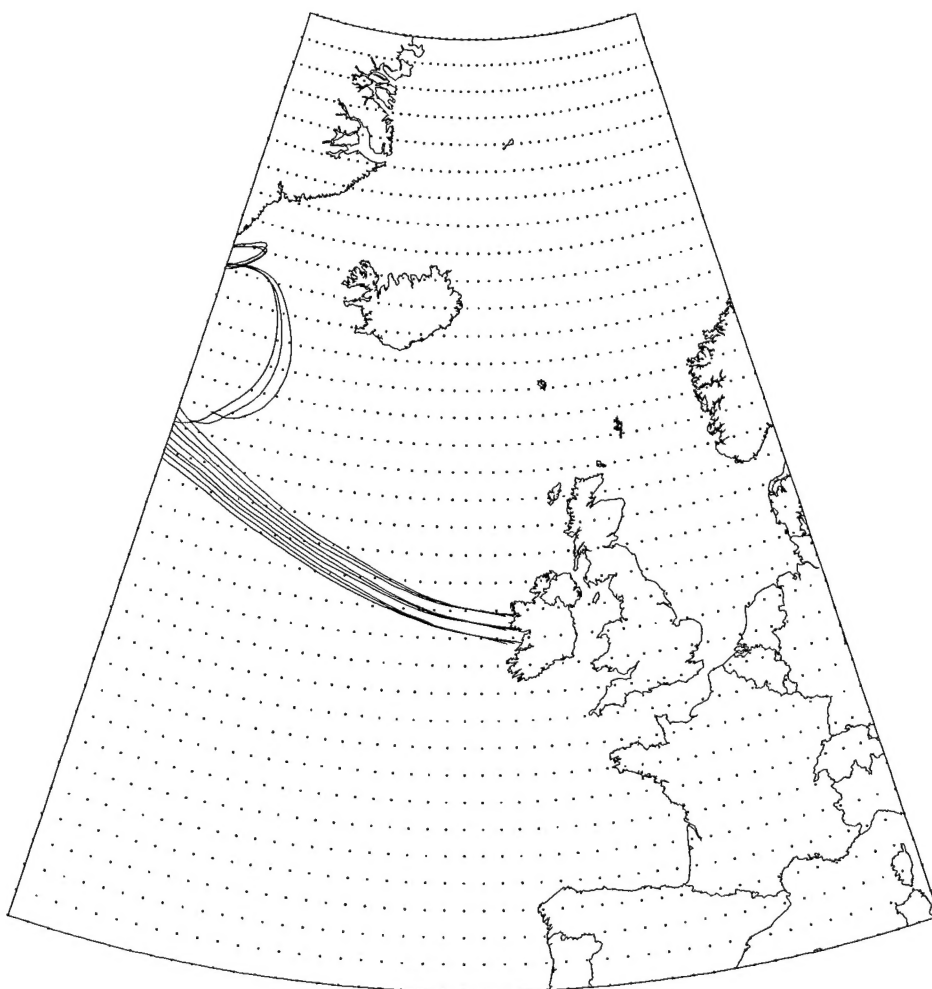
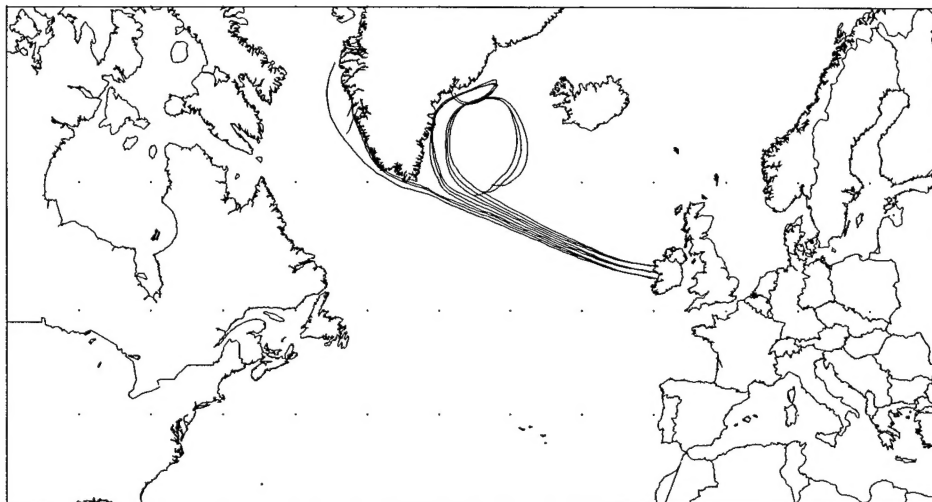
10 July 1996

Figure 5 (b)



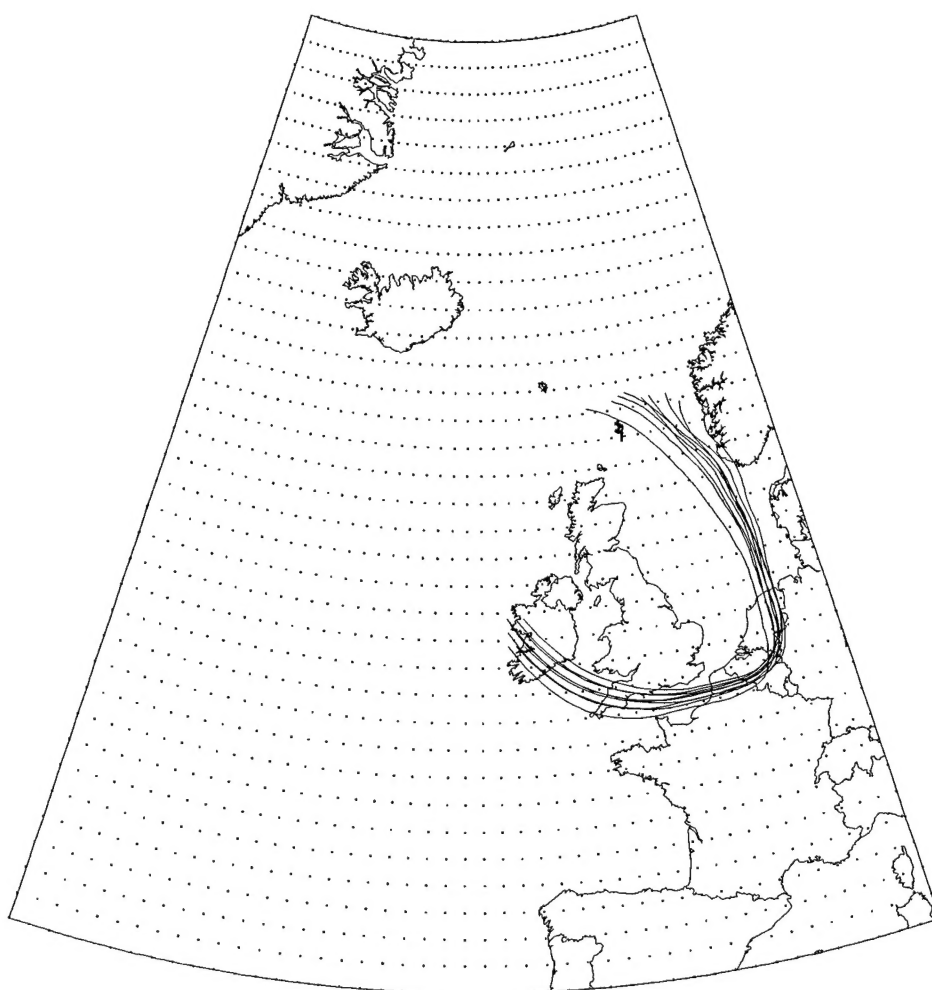
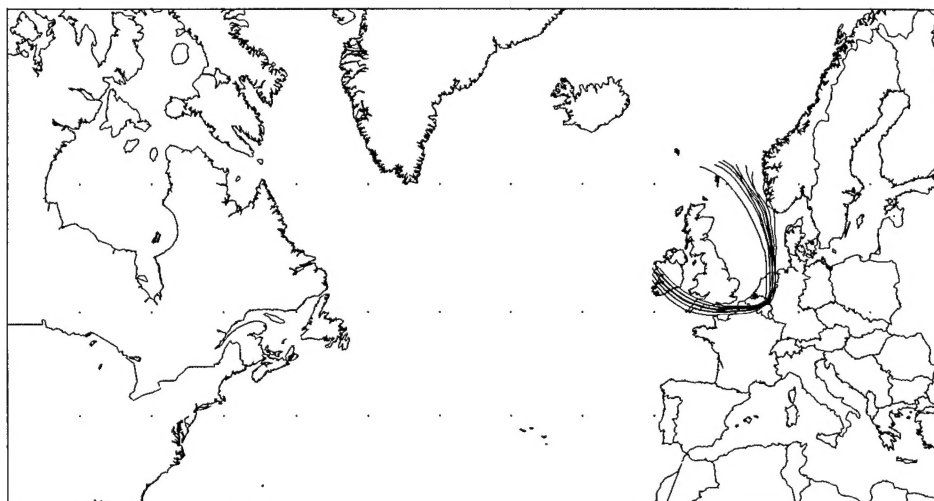
17 July 1996

Figure 5 (c)



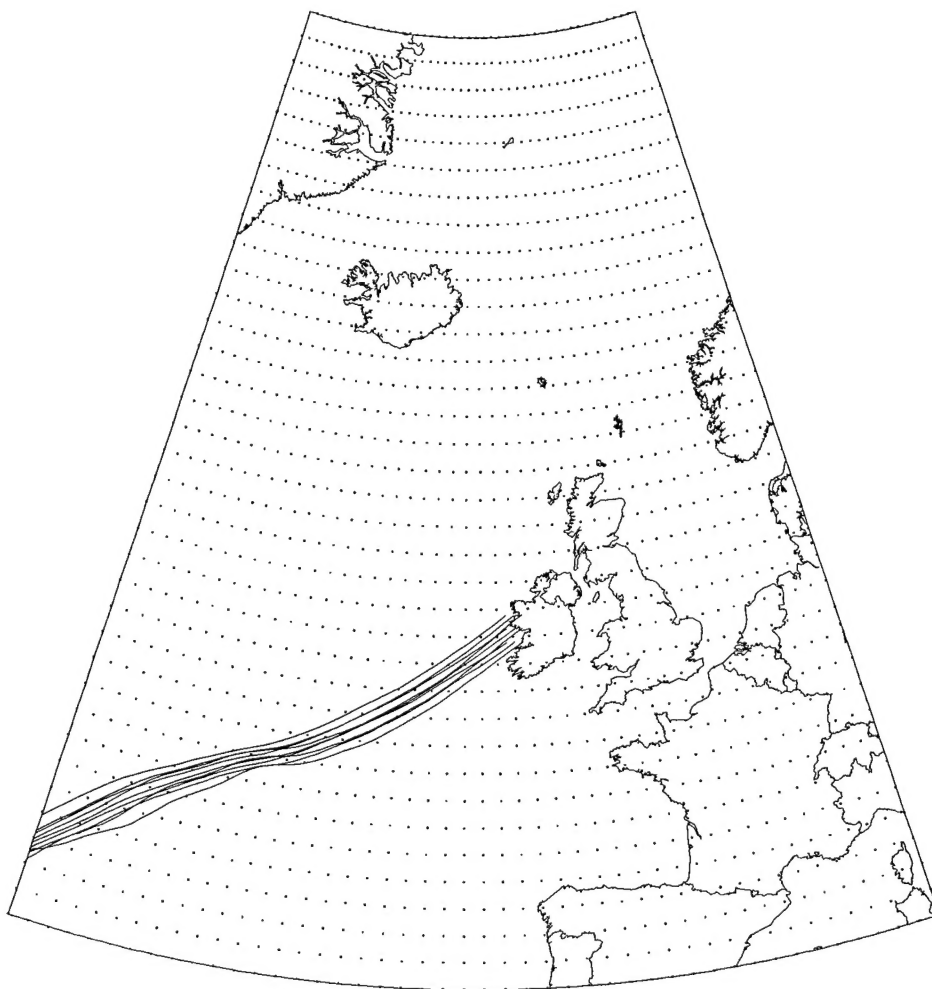
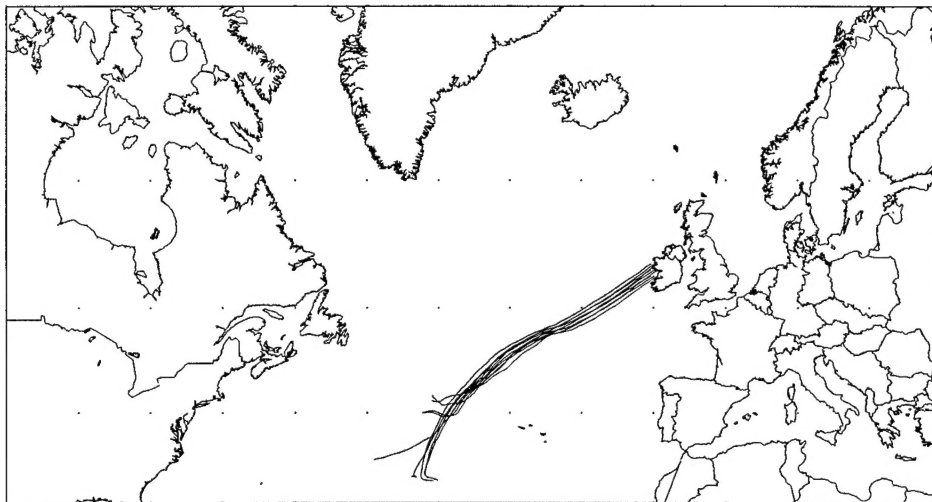
01 August 1996

Figure 5 (d)



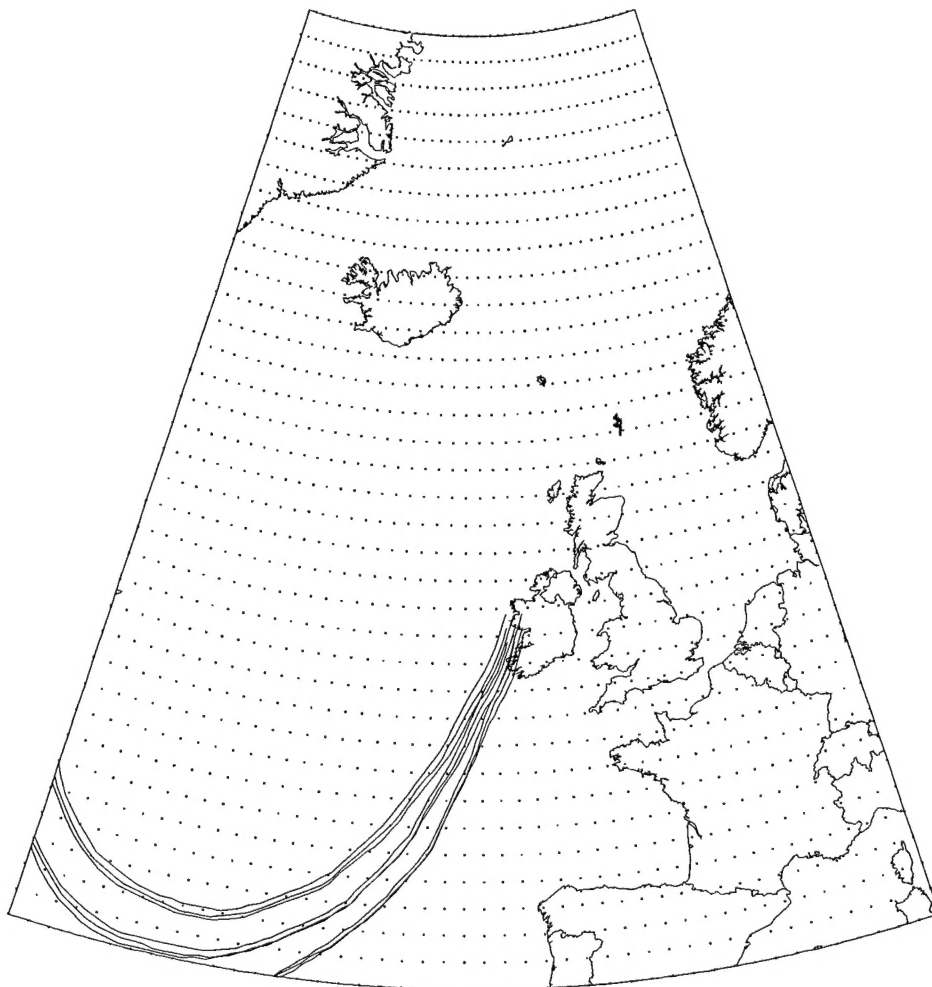
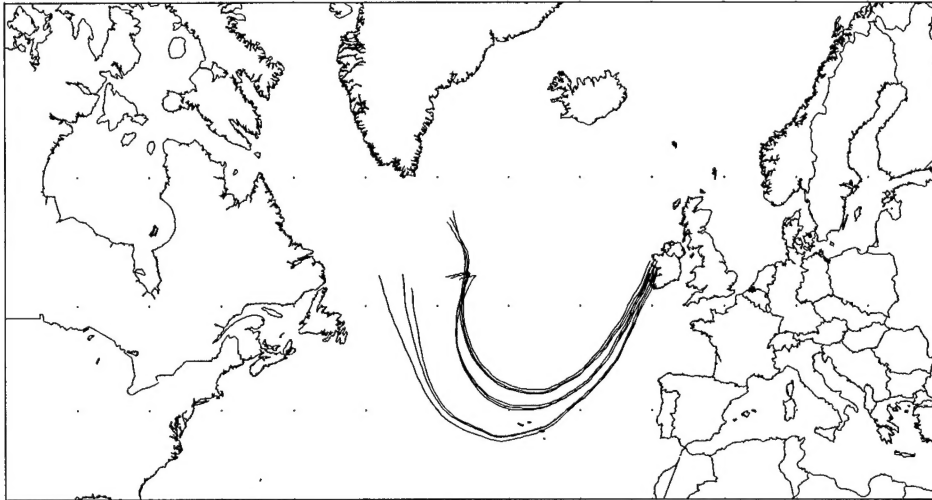
17 September 1996

Figure 5 (e)



26 September 1996

Figure 5 (f)



24 October 1996